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161, 6p. MAY 1972.

Research Note

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
INTERMOUNTAIN FOREST & RANGE EXPERIMENT STATION
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Research Note INT-161

May 1972

EFFECTS OF REMOVING POLE-BLIGHTED WESTERN WHITE PINE TREES ON GROWTH AND DEVELOPMENT OF A MIXED CONIFER STAND

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ABSTRACT

*A mixed conifer stand, in which western white pine (*Pinus monticola *Dougl.) was infected with the pole blight disease, was treated by removing either (a) all blighted trees, or (b) merchantable blighted trees. Neither treatment significantly altered the development of pole blight in the residual stand for 17 years following the cutting. The Douglas-fir (*Pseudotsuga menziesii *(Mirb.) Franco) component suffered heavy mortality, caused mostly by* Poria weirii *root rot; therefore, it had negative net growth for the period. Western redcedar (*Thuja plicata *Donn.), the predominant understory conifer, responded well to release and accounted for much of the basal area and cubic volume increment.*

Pole blight is a disease of complex origin affecting primarily dominant and codominant western white pine trees (*Pinus monticola* Dougl.) between the ages, usually, of 40 and 100 years. Evidence to date (Leaphart 1958; Leaphart and Stage 1971) indicates that the disease is triggered by prolonged periods of climatic drought when such trees having these characteristics are grown on soils of low moisture storage capacity (less than 5.0 inches in the upper 3-foot mantle) and on sites with low moisture recharge potential (e.g., upper or midconvex slopes).

In 1952, an 85-acre experimental area was installed on the Kaniksu National Forest in northern Idaho to test the effects of two types of overstory removal on (a) development of the pole blight disease in western white pine and (b) growth of understory conifers, particularly western redcedar (*Thuja plicata* Donn). Graham (1958) had found that by 1957, there was no significant difference among treatments on pole blight development. Since then, however, the blister rust fungus (*Cronartium ribicola* J. C. Fisch. ex Rabenh.) has confounded the first objective by causing death of enough western

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white pines so that progress of pole blight in the treated areas has been masked. Therefore, in this report we are concerned with growth responses and mortality of other species as well as of western white pine through 1969 when final measurements were made.

EXPERIMENTAL AREA AND STAND DESCRIPTION

The experimental area was located in a mixed conifer stand covering several thousand acres. Most of the area represented an intermingling of two ecological habitat types: the *Tsuga heterophylla/Pachistima myrsinites* type and the *Thuja plicata/Pachistima* type. Western redcedar was the predominant species in the understory of both of these types. The *Abies grandis/Pachistima* and *Pseudotsuga menziesii/Physocarpus malvaceus* habitat types were represented on smaller acreages of the drier upper slopes (Daubenmire and Daubenmire 1968).

Species composition and site productivity varied, especially between the moist, protected lower slopes and the drier, exposed ridges. The stand was even-aged, about 74 years old in 1952. Until the appearance of pole blight some 10 years previously, vigor of the stand had been good. The average site index was 70, based on the height of western white pine at 50 years of age (Haig 1932).

Plot elevations ranged from 2,600 to 3,200 feet. The plots extended from the foot of a north slope to a main east-west ridge. Four main intermittent streams drained the area to the north. Slopes averaged 25 percent having steep pitches up to 40 percent.

The soil was a very fine sandy loam. On gentle slopes, the soil was deeper than on the steep slopes and on ridgetops. Also, there was less rock in the surface layers on the gentle slopes. The parent material was a shale. Occasional gravelly sands or fragipans inhibited root penetration at depths between 18 and 24 inches. Over most of the area, available moisture storage capacity ranged between 5 and 6 inches in the upper 3 feet of soil.

EXPERIMENTAL DESIGN

The experimental area was divided into nine subunits of about 9.5 acres each. The following treatments were randomly applied in a Latin-square design to the nine subunits:

1. Control--no cutting;

2. Cutting of merchantable pole-blighted western white pine trees; and

3. Cutting of merchantable pole-blighted western white pine trees as well as poisoning of nonmerchantable trees.

A sample plot, composed of five 1/5-acre subplots, was established within each subunit. Diameters of trees >3.5 in. d.b.h. on these forty-five 1/5-acre plots were measured in 1952 (after completion of cutting) and in 1969. Heights of a sufficient number of trees were obtained in 1952 on each subplot to construct height-diameter curves for volume determinations; these heights were adjusted for the 1969 volume determinations.

Trees were examined for pole blight symptoms in 1952, 1955, 1957, and 1959, but not subsequently because of blister rust. Death of any tree and its cause, when determinable, were recorded when diameters were measured.

RESULTS

Analyses of variance of net growth and of mortality between 1952 and 1969 revealed no significant differences among treatments within any species. Therefore, only the means of the treatments by species are shown in table 1.

The impact of diseases, whether from blister rust or pole blight, on growth of western white pine was not altered by treatment. For most western white pines, the cause of death was impossible to determine. However, inasmuch as blister rust was rather randomly distributed throughout the 85 acres, we assume that western white pines that died from it were also randomly distributed. Considering this assumption to be valid, we believe that the trend observed by Graham (1958)--treatments had no influence on pole blight development--held through 1969 because we also found no significant differences in either growth response or mortality in western white pines resulting from the treatments.

DISCUSSION

Despite lack of significant response among other species to treatment, two other notable events are illustrated by the data (table 1): (a) Compared to other species, Douglas-fir (*Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco) suffered a marked growth loss in many subplots; and (b) western redcedar accounted for much of the basal area and cubic foot volume increment for the test period.

When the plots were established in 1950, high mortality of Douglas-fir was noted in a few localized areas. In 1969, most of the subplots had many dead Douglas-fir trees in all size classes. This mortality was caused primarily by *Poria weirii* root rot, recognized in the early 1940's as a potentially serious management problem for many Douglas-fir stands on the West Coast (Bier and Buckland 1947) but not for this stand at the start of the study. For all plots combined, the significance of the impact of this disease is reflected in actual loss of Douglas-fir increment amounting to nearly 14 cu.ft./acre/year (table 1). This loss contrasts with a potential net increase of nearly 23 cu.ft./acre/year for a comparable Douglas-fir component of normal western white pine stands having similar site and age characteristics (Watt 1960). Because no feasible control is yet available for *Poria* root rot (Childs 1970), "what the experimental design should have been to reduce losses from it" is perhaps a moot question. Nevertheless, our current knowledge would have suggested salvage of unhealthy appearing trees as a minimum effort.

With the release from cutting, as well as from mortality, of overstory trees, diameter growth of western redcedar responded in all plots; but the response varied considerably according to the original diameter and degree of release given each tree; e.g., the largest trees and those with least overstory competition usually responded with greatest diameter increment. Diameter increment averaged 2.9 inches for all trees on our plots, and some individuals grew as much as 6 inches. The lack of significant difference in growth response as a result of treatment is attributed, at least in part, to relatively equal release; i.e., overstory removal plus mortality in treated plots approximated that from mortality alone in the check plots.

Table 1.--*Stand statistics per acre for 1952 and for the 17-year treatment period (1952-1969)*

Species and treatment No.[1]	Trees[2]		Basal area		Cubic volume		Sawlog volume		1952-69 mortality	
	1952	Net increment	1952	Net increment	1952	Net increment	1952	Net increment		
			Square feet		*Cu.ft.*		*Board feet*		*Cu.ft.*	*Bd.ft.*
WESTERN WHITE PINE										
1	83	-30	72	-4	3,123	-34	15,516	844	859	4,035
2	69	-18	59	7	2,656	463	13,025	3,514	404	1,744
3	63	-15	57	8	2,583	458	12,897	3,396	288	1,212
DOUGLAS-FIR										
1	46	-13	47	-2	1,603	0	7,218	586	347	1,458
2	58	-23	56	-8	1,952	-207	8,495	18	591	2,254
3	50	-25	47	-16	1,623	-504	6,896	-1,606	776	3,232
WESTERN REDCEDAR										
1	73	41	16	19	343	502	657	1,166	12	0
2	30	22	6	14	122	384	164	898	6	0
3	33	32	5	16	114	412	14	874	5	2
OTHER SPECIES										
1	55	-4	40	1	1,180	37	5,935	408	259	952
2	28	8	21	7	788	257	3,291	1,370	28	65
3	38	1	28	5	1,039	202	4,195	1,218	129	459
ALL SPECIES										
1	257	-6	175	14	6,249	505	29,326	3,004	1,447	6,445
2	185	-11	142	20	5,518	897	24,975	5,800	1,029	4,063
3	184	-7	137	13	5,369	568	24,002	3,882	1,198	4,905

[1] Treatments: 1. Control, no cutting; 2. merchantable pole-blighted western white pine trees harvested; 3. merchantable pole-blighted western white pine trees harvested and unmerchantable ones poisoned.

[2] Trees 3.6 inches d.b.h. and larger.

The released western redcedars appeared vigorous and healthy, in contrast to those reported by Koenigs (1969). In his study, all the overstory trees were removed in a single cutting and the redcedars responded with rapid diameter growth for about 5 years, after which growth drastically slowed down and the trees developed chlorosis and resinosis. However, through 1970 we have noted a gradual increase of vigor and growth rate in many trees in the area studied by Koenigs. In our study, the cutting and subsequent mortality completely released some trees, but this release was gradual throughout the 17-year period. The apparent difference in results indicates a need for study of the response of western redcedar to different rates and amounts of release on varying sites. Also, even though the present growth rate is maintained, many more years will be required to harvest a substantial crop of cedar products from the area, primarily because of small average diameters of the trees at the start of the study.

Similarly mixed stands of the western white pine type usually have considerable mortality from all causes, averaging 2,520 bd.ft./acre in a comparable 20-year age period (Watt 1960). In this stand, mortality in western white pine, Douglas-fir, and lodgepole pine (*Pinus contorta* Dougl.)[2] was the chief reason for the check plots not achieving their potential increment. Additionally, some of the western white pine and Douglas-fir trees alive in 1969 were not growing as rapidly as might be expected, primarily because of the debilitating effects of their respective diseases. Most mortality and growth losses resulted from the combined effects of three diseases rather than from the effect of only pole blight. Whether the total losses could have been reduced, or should have been salvaged, by clearcutting or some other treatment in 1952 is not defined by our study because only the western white pine component was treated. Although mortality was higher in the study area (table 1) than reported by Watt, it was still lower than that occurring now in many other western white pine pole stands having similar disease problems. Thus, our study suggests that managers can greatly benefit from knowledge of the total disease complex prior to scheduling cultural operations, even if these operations can do little more than salvage impending mortality.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the assistance of R. F. Watt, who installed the study and who, with D. P. Graham, made many of the early periodic measurements; and of the many others in the Intermountain Station and the Kaniksu National Forest who assisted in plot installation, periodic measurements, and study termination.

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[2] Lodgepole pine is a short-lived species in habitats represented in the study unit; it accounted for most of the loss noted for the "other species" category in table 1.

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